



BALANCE CALIBRATION

PROCEDURE ID: YMP-LBNL-TIP/AFT 1.0

REV.1, MOD. 0

EFFECTIVE: 12/03/99

1. PURPOSE

This Technical Implementing Procedure (TIP) describes a method to calibrate laboratory balances for the Yucca Mountain Site Characterization Project (YMP) at Lawrence Berkeley National Laboratory (LBNL).

2. SCOPE

This procedure applies to calibrations of laboratory balances to be performed by all YMP-LBNL personnel (or contractor personnel following YMP-LBNL procedures) involved in laboratory testing for YMP activities subject to Quality Assurance Requirements and Description (QARD), DOE/RW-0333P. This procedure does not apply to YMP approved contractors on the Qualified Suppliers List (QSL) who provide calibration services using instruments traceable to the National Institute of Standards and Technology (NIST) or other national standards. Prior to conducting work described in Section 3.0 of this procedure, personnel performing calibrations require training to this procedure.

If this procedure cannot be implemented as written, YMP-LBNL personnel shall notify the responsible Principal Investigator (PI). If it is determined that a portion of the work cannot be accomplished as described in this TIP, or would produce undesirable results, that portion of the work shall be stopped and not resumed until this procedure is modified per YMP-LBNL-Quality Implementing Procedure (QIP)-5.2, *Preparing Development Plans & Quality/Technical Implementing Procedures*.

If the responsible PI determines that a modification or a revision to the TIP would cause an unreasonable delay in proceeding with the task, then an expedited change to the procedure, including documentation of deviation from the approved procedure, can be made according to YMP-LBNL-QIP-5.2. Such changes are subject to review, usually after the task has proceeded, and thus work performed under TIPs with expedited changes is done at risk of future invalidation.

Employees may use copies of this procedure printed from the controlled document electronic file; however, employees are responsible for assuring that the correct revision of this procedure is used. When this procedure becomes obsolete or superseded, it must be destroyed or marked "superseded" to ensure that this document is not used to perform work.

3. PROCEDURE

3.1 Principle

This TIP describes the detailed steps to calibrate balances internally at LBNL, in accordance with YMP Administrative Procedure (YAP)-12.3Q, *Control of Measuring and Test Equipment and Calibration Standards*. The objective is to determine functionality and accuracy of balances by recording and comparing balance readings in response to the standard weights of known accuracy. Pertinent information from equipment vendor manuals is incorporated into this TIP.

This procedure shall address the following requirements for the balances to be calibrated, per YAP-12.3Q:

- 1) Identification of standards to be used: see Section 3.4.1.
- 2) Detailed description of calibration method: see Section 3.4.
- 3) Consideration of manufactures' recommendations for storage and handling: see Sections 3.2.3 and 3.4.1.
- 4) Identification of tolerances and ranges of use: see Section 3.4.7.
- 5) Identification of calibration intervals: see Section 3.4.9.
- 6) Documentation: sufficient documentation shall be recorded in the scientific notebook and the calibration sticker: see Section 3.4.10.
- 7) Controls for nonconforming or out-of-tolerance conditions: see Section 3.4.7.
- 8) Recalibration of balance prior to use when updates to software contained in the balance affects calibration: not applicable.

3.2 Equipment

Standard weights, cotton or equivalent gloves, camel hair brushes and/or lint-free wipe, and padded or non-metal forceps are needed.

3.2.1 Equipment Malfunctions

The activities described in this procedure will determine any equipment malfunctions.

3.2.2 Safety Considerations

The activities described in this procedure do not require any special safety considerations other than the Environmental Health and Safety requirements that are utilized at LBNL.

3.2.3 Special Handling

To avoid scratching, standard weights shall be handled with cotton or equivalent gloves, or padded or non-metallic forceps. Standard weight set storage and access control shall be such as to avoid, to the extent possible, weight set corrosion or damage, and soiling from dust. For example, storage of weights in cases within a controlled cabinet or room should serve this purpose.

3.3 Preparatory Verification

Before using any standard weight(s), the staff member shall inspect them for obvious damage that may be detrimental to balance calibration. Any damaged weight(s) shall be labeled, tagged, or otherwise identified as not useable, in accordance with YAP-12.3Q, until their accuracy is verified.

3.4 Calibration Procedure

The Staff Member implementing this procedure shall ensure that:

- 3.4.1 Balances shall not be stored and handled in a manner detrimental to their performance. Determine if there are any factors that may be detrimental to good weighing, such as dust, vibration, air drafts, or temperature fluctuation. If a detrimental condition exists, correct it if possible and record actions in the scientific notebook, or if not possible, contact the PI for resolution. Perform a cursory check to observe whether the balance is damaged or in need of repair. If a decision is made to repair or replace the balance, document the decision and action taken in the scientific notebook and issue a Measuring and Test Equipment (M&TE) Out of Calibration Report (OCR) in accordance with YAP-12.3Q. The balance shall also have an M&TE Out of Service tag applied and be segregated.

Standard weight(s) used in this procedure must have been calibrated by a YMP approved, qualified supplier on the Office of Civilian Radioactive Waste Management (OCRWM) Qualified Supplier List (QSL). The standard weights shall have an accuracy greater than or equal to that of the balances to be calibrated. If standards used have an accuracy equal to that of the balances, in accordance with YAP-12.3Q, document the justification on the M&TE form or in a scientific notebook that

includes, as a minimum, the information required by the M&TE justification form. Visually inspect the standard weights prior to use, and check the calibration sticker to verify that the weight calibration has not expired. Record the unique identifiers of the standard weights and calibration information in the scientific notebook to ensure traceability.

- 3.4.2 For balances with built-in levels, observe whether the balance is level. If out of level, correct with adjusting screws.
- 3.4.3 Use a camel hair brush or lint-free wipe to gently brush away dust and particles, if any, on the weighing pan and surrounding area.
- 3.4.4 If the balance was not in a stand-by condition prior to calibration, power the balance on to allow it to warm up for sufficient time (e.g., 30 minutes). Construct a table with incremental weight values corresponding to the standard weights available. The accuracy of the balance shall be checked at various weight ranges by choosing at least five increments between these ranges. The ranges are dependent upon balance readability. For example, choose six increments in the range from 0.01 g to 0.1 g, six in the range from 0.1 g to 1 g and so on, up to the limit capacity of the balance, which determines the range of use.

If it is desired to calibrate a balance only over a certain range, this may be performed. However, the lower and upper calibration limits shall be stated in the scientific notebook and on the calibration sticker (see Section 3.4.8).

- 3.4.5 Zero the balance and place the weight or combination of weights on the pan of the balance and wait until the measurement is stable. A 30-second wait is sufficient to ascertain stability and drift. Remove the weight and wait until the balance reading returns to its original zeroed value. Re-zero the balance if necessary. Perform each of the measurements, as specified in the constructed table, in exactly the same manner.
- 3.4.6 Using selected standard weights (e.g., 0.1 g, 1 g, 10 g, 100 g, 1000 g), perform ten repeated measurements with each weight individually to evaluate the measurement precision and calculate the mean and standard deviation.
- 3.4.7 After completion of the calibration, plot the results and calculate the trend of the balance readings compared to the corresponding standard weights using a linear curve fit algorithm. Indicate

also the standard deviation and make a statement regarding the drift, if any. The suggested tolerances are within $\pm 0.1\%$ for standard weights > 100 grams, and $\pm 1\%$ for weights in the range of $1 - 100$ grams, and/or decided by PI. Determine if the balance meets the tolerances and record this determination in the scientific notebook. If a balance is found to be out of the allowed specification tolerance, an Out of Service tag shall be applied to the balance to indicate that it is not to be used in accordance with YAP-12.3Q.

- 3.4.8 For balances within the specified tolerances, prepare a calibration sticker similar to the example given in YAP-12.3Q indicating the unique identifier of the balance (manufacturer, model, serial number), date of the calibration, next calibration date and calibrator's name, the range of calibration if a particular range has been selected, and attach the sticker to the balance.
- 3.4.9 Perform the full balance calibration every twelve months or any time when the balance is moved. Conduct the balance performance check every six months by using selected standard weights (e.g., 0.1 g, 1 g, 10 g, 100 g, 1000 g). If the performance check shows that the balance reading is out of the allowed specification tolerance, apply an Out of Service tag and conduct the full calibration as specified from Section 3.4.4 to Section 3.4.8.
- 3.4.10 Documentation in the scientific notebook shall include the following information: the unique identification of the balance calibrated; date calibrated; calibration data, recalibration due date; procedure (including revision level) used to calibrate the balance; identification and calibration information of the standard weights used for the balance calibration; range of calibration; results of the calibration and statement of acceptability; as-found condition of the balance, as appropriate; specified range and tolerances and whether the balance meets those tolerances; personnel performing calibrations.

Document each usage of the balance on the M&TE Standard Usage Log from YAP-12.3Q, which is filed in the Equipment Logbook, with cross-reference to the scientific notebook.

3.5 Data Acquisition and Reduction

Data acquisition is done manually by recording the balance readings into the scientific notebooks according to AP-SIII.1Q, *Scientific Notebooks*. Standard computer software (e.g., Microsoft Excel) may be used to plot the results and to obtain a linear curve fit and standard deviation. No

routines or macros shall be used.

3.6 Potential Sources of Error and Uncertainty

Potential sources of error and uncertainty may result from human error in recording or reading the data. Repeating individual measurements is the best way to ascertain that no errors are made. If balances do not hold their calibration throughout the process, they shall be repaired or suspended from usage. According to YAP-12.3Q requirements, the balance shall have an M&TE Out of Service tag applied and be segregated. An OCR shall also be prepared and an evaluation of the data shall be performed. If the evaluation determines that the data is impeded, a Nonconformance Report (NCR) shall be documented in accordance with YAP-15.1Q.

3.7 Acceptance Criteria

The ability to calibrate balances within the specified tolerance, affixing a calibration sticker to the calibrated item, and proper completion and filing of the records listed in section 4.0, constitutes the acceptance criteria for this procedure.

4. RECORDS

4.1 Lifetime

Records generated as a result of this TIP are entries in:

- Scientific notebooks or attachments to such notebooks
- Equipment Logbooks (includes M&TE Justification Form, if appropriate, and Standard Usage Log)
- M&TE Out of Calibration Report, if applicable

4.2 Non-Permanent

None

4.3 Controlled Documents

This Technical Implementing Procedure

4.4 Records Center Documents

Records associated with this procedure shall be submitted to Records Processing Center (RPC) as a scientific notebook records package in accordance with AP-17.1Q, *Record Source Responsibility for Inclusionary*

Records.

5. RESPONSIBILITIES

5.1 The **Principal Investigator (PI)** is responsible for assuring full compliance with this procedure and providing training thereof. The PI is responsible for overseeing and coordinating the preparation, review, distribution, revision, and recommending rescission of the TIP.

5.2 **Staff Members** are responsible for following this procedure and turning over related documentation to the Records Coordinator for submittal to the RPC in accordance with AP-17.1Q. Related data shall be turned over to Technical Data Coordinator in accordance with YMP-LBNL-QIP-SIII.3, *Submitting Key Data to the Yucca Mountain Project Office*, for entry into the YMP Technical Database Management System (TDMS).

6. ACRONYMS AND DEFINITIONS

6.1 Acronyms

AFT	Ambient Field Testing
EA	Engineering Assurance
LBNL	Lawrence Berkeley National Laboratory
M&TE	Measuring and Test Equipment
NCR	Nonconformance Report
NIST	National Institute of Standards and Technology
OCR	Out of Calibration Report
OCRWM	Office of Civilian Radioactive Waste Management
OQA	Office of Quality Assurance
PI	Principal Investigator
QARD	Quality Assurance Requirement and Description
QIP	Quality Implementing Procedure
QSL	Qualified Suppliers List
RPC	Records Processing Center
TDMS	Technical Database Management System
TIP	Technical Implementing Procedure
YAP	YMP Administrative Procedure
YMP	Yucca Mountain Site Characterization Project

6.2 Definitions

Calibration: Comparison of a measurement standard or instrument of known accuracy with another standard or instrument to detect, correlate, report, or eliminate by adjustment, any variation in the accuracy of the instrument or equipment being compared.

Staff Member: Any scientist, engineer, research or technical associate, technician, or student research assistant performing quality-affecting work for YMP-LBNL.

Technical Implementing Procedure: Each TIP describes YMP-LBNL technical tasks that (1) are repetitive, (2) are standardized, and (3) can return different results if deviation from the sequence of steps occur.

7. REFERENCES

AP-17.1Q, *Record Source Responsibility for Inclusionary Records*

AP-SIII.1Q, *Scientific Notebooks*

DOE/RW-0333P, *Quality Assurance Requirements and Description*

YAP-12.3Q, *Control of Measuring and Test Equipment and Calibration Standards*

YAP-15.1Q, *Control of Nonconformances*

YMP-LBNL-QIP-5.2, *Preparing Development Plan & Quality/Technical Implementing Procedures*

YMP-LBNL-QIP-SIII.3, *Submitting Key Data to the Yucca Mountain Project Office*

8. ATTACHMENTS

None

9. REVISION HISTORY

07/08/98 – Revision 0, Modification 0:

This TIP was initially a methodology prepared by Roberto Suarez-Rivera on August 9, 1996. It was part of the scientific investigation presented in the YMP-LBNL-JSW-Laboratory Equipment Log Book.

12/03/99 – Revision 1, Modification 0:

Revised procedure to meet YAP-12.3Q requirements and incorporate inferences to other applicable APs and YAPs.

10. APPROVAL

Signature on file

Preparer: Q. Hu

Date

Signature on file

Technical Review: T.J.Kneafsey

Date

Signature on file

Technical Review: R. Stover

Date

Signature on file

EA Review: N. Aden-Gleason

Date

Signature on file

OQA Concurrence: S. Harris

Date

Signature on file

Principal Investigator: J. Wang

Date

Signature on file

Project Manager: G.S.Bodvarsson

Date